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The Student Body of the College of Agriculture

Los Baños, Philippines

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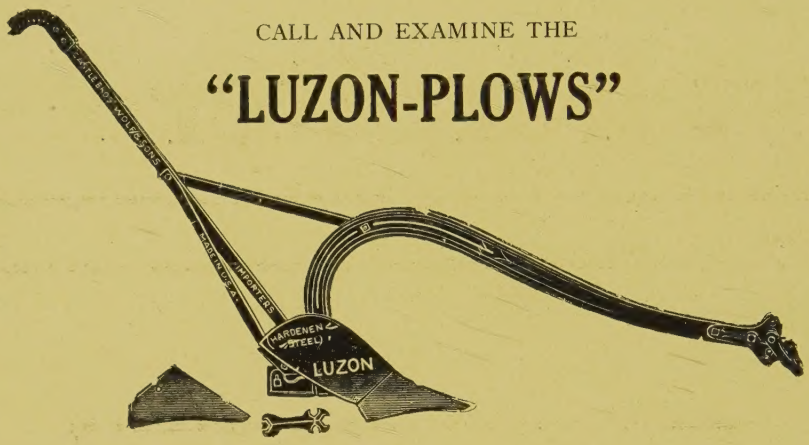

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Cultivated Aroids

By F. A. Quisumbing

(*Concluded.*)

Varieties

Nature does not allow us to build clear cut synopses of numerous varieties of cultivated plants, the wide variability of individuals rendering this impossible. Hence we must depend on average characters, and on the sum of all characters, to distinguish varieties. This must be kept clearly in mind in using the following synopses. Often a plant must be tried under several heads and eventually referred to, or placed near, that variety the sum of whose characters most nearly approaches its own. The synopses serve merely as general guides in such work.

Identification of Varieties of Colocasia; Gabis

A. *Taros* (in Barrett's sense). With runners, usually 1 ft. long or more, about 0.5 cm. diam.; rootstock usually tuberless.

B. Midrib 4-5 or equal to free portion of the petiole.

C. Sheath 1⅓ to 1½ times free portion of petiole.

D. Petiole greenish purple.

E. Young petioles maroon, old ones purple; color of flesh of tuber light rose. (1640) *Gabi Muros.*

EE. Greenish purple above, green below; tuber light rose with pinkish fibers. (1044) Gabi Hinongot. (1049) *Gabi Tinamban.*

EEE. Petiole dark green with some purple shade below, dark purple green above; tuber white with yellow fiber. (1851) *Wild variety.*

EEEE. Petiole light green, purple shade found more in young petioles; tuber cream with yellow and pinkish fibers. (1850) Wild variety, *Los Baños.*

DD. Petiole dark purple; tuber yellow. (1639) *Gabi Sanlay.* (yellow var.)

DDD. Petiole streaked, green, with white; tuber white with yellow fibers. (1638) (a) *Gabi Sanlay.* (light rose var.)

CC. Sheath 2 times free portion of petiole; tubers pinkish yellow. (1047) *Gabi Hinagnayon.*

BB. Midrib ⅔ to 4/5 times free portion of petiole.

C. Sheath 1⅓ to 1½ times free portion of petiole.

D. Petiole streaked; tuber white with yellow fibers. (1052) *Gabi Manong.*

DD. Petiole greenish purple; tuber rose or whitish yellow.

E. Purple more prominent, especially wings of sheath.

F. Purple extends from midrib to base, color more prominent in young petioles; inner sheath purple. (1638) (b) *Gabi Sanlay.* (yellow var.)

EE. Dark green more prominent, purple less; tuber rose with yellow fibers. (1043) *Gabi Minamban.*

EEE. Petiole light green, in young petiole purple more prominent and spotted with green; tuber white with yellow fibers. (1584-586) Unknown Variety.

CC. Sheath 1¼ to 1⅓ times free portion of petiole.

D. Petiole streaked; tuber white with yellow fibers.

E. Petiole above purple, below cream streaked with green and purple lines; inner sheath cream streaked with green. (1055) *Gabi Siniñora.*

EE. Petiole above cream slightly streaked with purple, below purple more prominently streaked; inner sheath cream not streaked. (102) *Gabi Smooth Black.*

DD. Petiole greenish purple.

E. Greenish purple above, green below; tuber rose with pink fibers. (310) *Gabi Rough Samar.*

EE. With purple streaks, tuber cream or yellow with pink fibers. (901) *Gabi Kinalikut.*

DDD. Petiole reddish purple.

E. Light-colored.

F. Leaves flat, hanging down, small plants; tuber white with yellow fibers. (1045) *Gabi Cabató.*

FF. Leaves concave, tall plants; tuber white with yellow and pink fibers. (1056) *Gabi Manalod Red.*

EE. Dark-colored.

F. Leaves flat, small plants; tuber yellow with pink fibers. (1054) *Gabi Initlog.*

FF. Leaves concave, tall plants; tuber pinkish. (1051) *Gabi Manalog Tinampay.*

DDDD. Petiole whitish green or cream with numerous grey-purple markings; young petioles all greyish purple; tuber white with yellow fibers. (1046) *Gabi Calpan.*

DDDDD. Petiole whitish green or cream with less numerous grey-purple markings; tuber white with yellow fibers. (1048) *Gabi Paahindaraga.*

DDDDDD. Petiole greyish-purple; tuber white with yellow fibers. (1041) *Gabi Manalog Busog.*

CCC. Sheath 1⅔ times free portion of petiole.

Petiole reddish purple; tuber white with yellow fibers. (1053) Gabi Baligguat.

BBB. Midrib ⅓ to ½ times free portion of petiole.

Sheath 1⅓ to 1¼ times free portion of petiole.

D. Petiole creamy or greyish-white; tuber white with yellow fibers. (1042) *Gabi Manlaban.*

AA. *Dasheens* (in Barrett's sense). Without runners; sprouts appear either directly from main stock or from side tubers; rootstock surrounded with tubers.

I. True dasheens.

Tendency to produce tuber-like offset at the surface of the ground; side tubers numerous.

B. Midrib ⅔ to ¾ times free portion of petiole.

C. Sheath. 1⅓ to 1¼ times free portion of petiole.

D. Petiole green streaked with cream markings; tuber cream or yellow. (1050) *Dasheen Pinalawan.*

DD. Petiole green; tuber white.

E. Tall and vigorous plants. (431) *White Edda Dasheen.*

EE. Small plants, 1 ft. high. (945) *Dasheen Puti.*

DDD. Petiole dark green below, purple above; tuber white with pinkish fibers; very odorous.

E. Main tuber small, long; fibers in flesh few, veins purple. (1717) *Hongkong.*

EE. Main tuber large, long; fibers in flesh few, veins purple. (1718) *Chinese Dasheen.*

EEE. Main tuber large; fibers large, numerous: veins purple. (1719) *Chinese Dasheen.*

EEEE. Main tuber small, fibers large. (951). *Dasheen Sungsong.*

CC. Sheath 1½ or more times free portion of petiole; tuber white. (433) *Colocasia Kelly No. 16.*

CCC. Sheath 1⅓ to 1½ times free portion of petiole; tuber white with pinkish rough fibers. (1711) *Dasheen Karayo.*

BB. Midrib 4/5 to 1¼ times free portion of petiole.

C. Sheath equal to or exceeding free portion of petiole.

D. Petiole green.

E. Tubers small, smooth thin, few hairy materials; segments few.

F. Average tubers small, round, numerous, long tubers few. (437) Unknown variety.

FF. Average tubers large, long, numerous, small tubers few. (947) *Dasheen Lasuna.*

EE. Tubers large covered with dark brown rough hairy materials; segments numerous. (432) *Colocasia No. 17.* (435) Unknown Variety.

DD. Petiole greyish purple below, green above. (950) *Dasheen Malabong Puti.*

CC. Sheath 1½ to 1⅔ times free portion of petiole.

D. Petiole dark greenish purple.

E. Main tubers long and oblong (308) *Los Baños Dasheen.*

EE. Main tubers round and flat. (944) *Dasheen Malabong Pula.* (1641) *Dasheen Sinibuyas.*

DD. Petiole dark greenish purple with green lines along petioles. (1848) *Calamba Dasheen.*

DDD. Petiole all green. (1847) *Colocasia sp.*

CC. Sheath 1⅓ to 1½ times free portion of petiole.

D. Petiole green. (1845) *Colocasia sp.*

DD. Petiole dark green. (1637) Colocasia Sp. S. P. I. No. 15382. U. S. D. A.

CCC. Sheath 1¼ to 1⅓ times free portion of petiole. (495) *Mindoro Gabi. II. Modified Dasheen.*

Tendency to throw up sprouts from tips of tubers forming corm like offsets combined into a multiple headed clump; tip throws indefinite number of buds.

(1849) Dasheen Tapal.
(1852) Colocasia Sp.
(585) Colocasia Sp.
(1846) Colocasia Sp.

Identification of Varietes of Yautias

I. Basal wings reaching petiole.

A. Midrib 1⅓ to 1½ times free portion of petiole.

B. Sheath 2 to 2½ times free portion of petiole.

C. Petiole purple or maroon at least within sheath; lead blade purple green; veins under leaf blade purple; tubers yellow or cream; oval or round in shape. (440) *Prieta Yautia.*

CC. Petiole and leaf blade all green; tuber white. (443) *Gray Jack Yautia.*

AA. Midrib 1 1/5 to 1¼ times free portion of petiole.

Petioles greenish purple; sheath within green; maroon along wings of sheath; tubers ovoid, flesh rose or pink. (441) *My Lady Yautia.*

AAA. Midrib equal to or 1 1/5 times free portion of petiole.

Leaves large and flat; sprouts appear from inner sheath, main tuber yellow; no side tubers are produced. (1721) Unknown Variety.

II. Basal wings not reaching the petiole; tubers all white.

A. Midrib 1¾ to 2 times free portion of petiole.

B. Sheath 2⅓ to 2½ times free portion of petiole; tubers long, medium size, with few roots, madres small. (438) *Banana Tatin Yautia.*

AA. Midrib 1⅔ to 1¾ times free portion of petiole.

B. Sheath 2½ to 2¾ times free portion of petiole; madres large and long; tubers with numerous roots. (436) *Punyera Yautia.*

BB. Sheath 2⅓ to 2¼ times free portion of petiole; tubers medium size, roots few. (444) *Rolliza Yautia.*

BBB. Sheath 1⅔ to 1¾ times free portion of petiole, tubers large, tendency to produce many sprouts. (430) *Malanga Blanca.*

AAA. Midrib 1½ to 1⅔ times free portion of petiole.

B. Sheath 1 4/5 to 2¼ times free portion of petiole; tubers flat, ovoid, hairy; tendency to produce many suckers. (434) *White Tamma Yautia.*

AAAA. Midrib 1⅓ to 1½ times free portion of petiole.

B. Sheath 1¾ to 2 times free portion of petiole; tubers large, plants small. (589) Unknown Variety. (1678) Unknown Variety.

BB. Sheath 2 to 2¼ times free portion of petiole; tubers medium, plants medium. (1720) Unknown Variety.

BBB. Sheath 1⅔ to 1¾ times free portion of petiole; tubers long and small (442) *Taro Royal.*

AAAAA. Midrib 1¼ to 1⅓ times free portion of petiole.

B. Sheath 1½ to 1⅔ times free portion of petiole; plants small. (587) Unknown Variety.

BB. Sheath 1 4/5 to 2 1/5 times free portion of petiole; plants large. (309) *Rolliza Yautia.*

AAAAAA. Midrib 1 to 1¼ times free portion of petiole.

B. Sheath 1½ to 1⅔ times free portion of petiole; plants small, tubers white. (588) Unknown Variety.

BB. Sheath 1⅓ to 1½ times free portion of petiole; plants medium, tuber rose. (1521) *San Fernando Po.*

BBB. Sheath 1¼ to 1½ times free portion of petiole; plants small, tuber white, poor producer of tubers. (439) *Trinidad Yellow Yautia.*

Identification of Varieties of Alocasia

A. Midrib 1 4/5 to 2 times free portion of petiole; main tuber white, rough.

B. Sheath 2⅓ to 2¼ times free portion of petiole.

C. Petiole and leaf blade set up straight and vertical. (1057) Talian Titum.

BB. Sheath 1⅔ to 2 times free portion of petiole. (1059) *Talian Burag.*

BBB. Sheath 4/5 to 1⅓ times free portion of petiole. (121) *Talban Tuberculo.*

AA. Midrib 1⅔ to 2 times free portion of petiole.

B. Sheath 1⅓ to 1⅔ times free portion of petiole. (1058) *Talian Busog.*

Identification of Varieties of Cyrtospermum

A. Sheath ⅔ to ¾ times free portion of petiole.

B. Tall plants, not flowering. (1038) *Palawan Talingaon.*

BB. Small plants, flowering. (311) *Palawan Gabi.*

AA. Sheath as long as free portion of petiole. (1039) *Palawan Binabaya.*

COLOCASIA

Varieties of Gabi

According to methods of producing sprouts, methods of growth and character of tubers, gabis as a whole may be classified as follows:

1. The Taros.

Usually reproduce sprouts through runners or underground stems, 1 to 3 feet long and 5 to 1 cm. diameter, covered with brown or purple skins, nodes 2 to 4 inch long; rootstocks usually tuberless.

They may still be classified according to the color of the petiole and leaf.

1. **Greenish purple** varieties.

310. Gabi, Rough Samar, received from 1912 Exposition. The plant is about ½ to 1 meter high. The petiole is green below, and dark-purple-green above. Wings of the sheath, pink. Young leaves, midrib, veins of the lateral leaf blade are slightly colored with pink. The tuber is nearly cylindrical and covered with a brown fibrous skin. The flesh is light rose. The fibers numerous and of pinkish color.

Tuber 10 cm. in diameter, and 16 cm. long. When cooked it is very mealy and delicious.

1049. Gabi Tinamban from Tanawan, Leyte. The plant looks very much like No. 310 but the tuber is different in shape. The flesh of tuber is light rose in the middle and deep rose around the border. Fibers pink and yellow and numerous. Tuber 8 cm. in diameter, and 15 cm. long. When cooked it is mealy.

1044. Gabi Hinongot, from Tanawan, Leyte. A variety which looks the same as the above (310), but shape of the tuber is different. Rose-fleshed and fibers numerous and pinkish. Tuber 6 cm. in diameter and 11 cm. long.

1043. Gabi Minamban from Tanawan, Leyte. A variety whose petioles are dark green in color. Purple color is found slightly along wings of the sheath, in the upper part of the petioles and young petioles. Flesh of the tuber slightly rose color inside, and clear rose along the border of the tuber. The fibers are numerous and of yellowish color. When cooked it is watery or soggy. Size upper diameter 6 cm. Size lower diameter 3 cm. Size length 19 cm.

1584.—(586) Unknown variety, supposed to be wild. A variety found growing wild along the creeks of the college farm. The petioles are light green below and purple above. Young petioles and wings of the sheath are reddish-purple and sometimes spotted with purple-red blotches. Midrib and lateral veins colored with bright-reddish-purple. Runners and sprouts numerous. The flesh of the tuber is white and with numerous yellow fibers. The flesh when cooked is soggy and "poisonous." Tubers are very rough. Size, 6 cm. diameter. 11 cm. length.

1638 (a), Gabi Sanlay light rose var., from Mahayhay, Laguna. A variety commonly found in the market of Calamba and most esteemed by the people because of its mealy tubers. The color of the petioles is the same as in No. 310, but the reddish purple color is more prominent. The flesh is light-rose-color with numerous rough pink fibers. When cooked it is mealy and suggestive in flavor. Size, 10 cm. diameter. 14 cm. length.

901. Gabi Kinalikut, from Morong, Rizal. A variety whose petioles are dark greenish purple above and dark green below. Inner sheath slightly colored with purple. The flesh is yellow or cream with numerous light pinkish fibers. It is mealy but acrid in taste.

Size, 6 cm. in diameter. Size, 15 cm. in length.

1851. Wild variety, Los Baños. The some as No. 901.

II. Reddish-purple-colored varieties.

1053, Gabi Baligguat from Tanawan, Leyte. A variety whose petiole is reddish-purple in color. Leaves round or nearly so. Leaves large and hanging down. The flesh of the tuber is white with numerous yellow fibers. Size, 9 cm. diameter. 16 cm. length.

1640, Gabi Muros from Calamba beach. A variety of light-reddish-purple color, found growing wild along the beach of Calamba. It produces numerous runners and sprouts. Tubers oblong or almost round, covered with dark brown fibrous material. Flesh, yellow and soggy.

1056, Gabi Manalod Red, from Tanawan, Leyte. A variety which appears to be the same as above described but the purple color is prominent. Petioles are set up nearly vertical. Leaves are small, nearly half as large as in No. 1053, curved in and vertically pendent. Good producer of sprouts. The flesh of tuber is white with pink and yellow fibers. Fibers numerous and finely webbed. Size, 8 cm. diameter. 13 cm. length.

1045, Gabi Cabató from Tanawan, Leyte. A variety, like No. 1056, but small, and leaf blade flat and hanging down. The flesh is white with numerous yellow fibers. Size, 7 cm. diameter. 9 cm. length.

III. Dark-purple-colored varieties.

1051, Gabi Manalod Tinampay, from Tanawan, Leyte. A variety whose color is dark purple, inner sheath reddish purple. Petiole near base, especially the young petiole, is clearly marked with reddish purple color and streaked with green lines. The plant is large and leaf blade curved in and set up straight. Flesh of tuber whitish pink in the middle and clear pink along the border. Fibers numerous and of pink color. Size, 9 cm. diameter. 14 cm. long.

1639, Gabi Sanlay, yellow var., from Mahayhay, Laguna, received through Calamba market. A variety which looks the same as No. 1051 but inner sheath cream, netted with purple veins. Tuber is yellow with large fibers. It is called "bunlos." Six tubers of the size given below cost 30 centavos in the local markets. Size, 10 cm. diameter. 15 cm. length.

1850, Wild Variety, Los Baños. A variety found along the banks of the College creek growing wild. The petioles are colored light green. The plants are characterized by sending out many runners or sprouts. Tubers are colored cream with purple fibers and yellow. When cooked, they are mealy but very acrid. Tubers are very small.

1054, Gabi Initlog, from Tanawan, Leyte. A dark purple variety. Plants small, and inner sheath reddish purple. Good producer of suckers. Flesh of tuber is yellow or cream with pinkish fibers. When cooked it is soggy. Size, 9 cm. diameter. 10 cm. length.

IV. Streaked-colored varieties.

1052, Gabi Manong, from Tanawan, Leyte. A variety whose petioles are colored dark green streaked with cream lines, and in young petioles, pinkish lines, mixed with cream ones; sheath wings pink; upper part of petiole, purple. Tuber white with numerous yellow fibers. Size, 8 cm. diameter. 14 cm. length.

1638 (b), Sanlay, white var., from Mahayhay, Laguna, received through Calamba market. The plant is nearly the same as above (1052), but pink lines are more prominent in upper petiole, and there is a reddish purple shade along wings of sheath. Color of tuber and shape, the same as No. 1052.

1055, Gabi Sininora, from Tanawan, Leyte. Plants whose petioles are colored cream with reddish-purple and green

lines running along them. Cream color being prominent along the base, and pink above. Sheath wings reddish in color. The tubers are almost round, and the flesh white with yellow and pink fibers, the latter being larger and more numerous. Size, diameter 10 cm. length 12 cm.

102, Gabi Smooth Black, from Tanawan, Leyte. Plants with creamish-green petioles, or pinkish-grey more prominent in young petioles and at the base of old ones. The upper part of the petiole, creamish-green with a purple shade near midrib. Good producer of suckers. Tubers white with numerous yellow fibers. Size, diameter 8 cm. length 10 cm.

V. Greenish-white or cream-colored varieties.

1046, Gabi Calpan, from Tanawan, Leyte. Plants with cream-colored petioles. Grey color is found slightly along sheath of petiole, but prominent in young petioles and upper part of all petioles. Tubers white with numerous yellow fibers. Size diameter 8 cm. length 14 cm.

1048, Gabi Paahindaraga, from Tanawan, Leyte. Plants the same as above but grey color less prominent. Tubers white with numerous yellow fibers. Size, diameter 10 cm. length 18 cm.

1042, Gabi Manlaban, from Tanawan, Leyte. Plants with creamish-green color and petiole slightly colored grey. Plants large, about one meter high or more. Tubers white and with yellow fibers. Size, diameter 7 cm. length 13 cm.

VI. Greyish-purple varieties.

1041, Gabi Manalod Busog, from Tanawan, Leyte. Plants whose petioles below are dark-greyish-purple, and above green. Petioles straight, holding up concave leaf blade. Wings of sheath slightly colored with pink. Tubers, white with numerous yellow fibers. Size, diameter 7 cm. length 13 cm.

1047, Gabi Hinagnayon from Palo, Leyte. Plants whose petioles are dark-greyish-green below, and dark-greyish-purple along wings of sheath. Young petioles greyish-purple, above green. Petiole drooping, with a flat and hanging leaf blade. Tubers yellow around the border and pink in the middle. Fibers both yellow and rose, and numerous.

2.—Dasheens

Plants do not have runners from which sprouts originate; sprouts appear either directly from the main tuber or side tubers; rootstock usually tuberless.

A. True dasheens. Tendency to produce tuber-like offset at the surface of the ground; side tubers numerous.

I. Green colored varieties.

Dark green.

433, Colocasia Kelly No. 16. Dasheen from Porto Rico Agric. Expt. Sta. A variety about ½ meter high with dark-green color and young petioles and wings of sheath slightly colored with light-reddish-pink. The main tuber is oblong or round, about 9 cm. in diameter and 10 cm. long. Side tubers are strongly attached to main tuber. The tuber is covered with a thin skin and with brownish fibrous material. Color of flesh is white, with yellow fibers in the main tuber and none in the side tubers. When cooked it is very mealy.

1637, Colocasia sp. S. P. I. No. 15,382 U. S. D. A. A variety similar to No. 433, but plants are small and main tuber is mostly round with a projection at the end. Plants give smaller yield than the above variety.

Light green.

(Small varieties, dwarfs). When cooked tubers are soggy or watery.

437, Unknown Variety of dasheen. Received from Porto Rico Agri. Expt. Sta. as Red Tacca Yautia. A variety 1 meter high, producing numerous small tubers attached at top of each other. Main tuber is about 5 cm. in diameter

and 10 cm. long, or even smaller, and side tubers 2 cm. in diameter and 5 cm. long. The small ones are round; segments of tubers, few. Tubers are covered with smooth thin skin, not fibrous. Outer portion of skin is green, inner flesh white. Time for maturing 5 to 7 months, depending upon climatic conditions.

947, Dasheen Lasuna, from Morong, Rizal. A variety similar to No. 437, but purple in shade along wings of sheath and end of petiole near midrib. Shape of main tuber is the same as above but side tubers are larger and longer. Small tubers few. Tuber characters as to color and quality are the same as No. 437.

432, Colocasia No. 17. Dasheen from Porto Rico Agric. Expt. Sta. A variety similar to No. 947. Side tubers are larger and oblong, and with numerous segments, covered with thick rough brownish, fibrous materials. Flesh of tubers white, and poor yielder.

435, Unknown Variety of dasheen. Received from Porto Rico Agric. Expt. Sta. as Yautia Amarilla. A variety similar to No. 432 except that it is a better yielder.

945, Dasheen Puti, from Morong, Rizal. A variety similar in character to No. 437.

Large varieties.

1845, Colocasia sp. from Morong, Rizal. A variety with light green petioles. Petioles long, supporting round leaf blades. Formation of tubers is the same as in Nos. 947 and 437, but they are closer and more strongly attached to main tuber. Tubers have numerous roots. Flesh of tuber white.

1847, Colocasia sp. from Morong Valley, Rizal. A variety with petioles all green, leaf almost round. Tuber is covered with smooth, light-brown, not fibrous skin. Main tuber is oblong or mostly round. Side tubers are long and cylindrical, spreading like fingers. Diameter 2 cm., length 20 cm. Flesh of tuber is white.

431, White Edda Dasheen from Porto Rico Agric. Expt. Sta. A variety about 1 meter high, with leaf blades large and petioles long. Tubers are large and nearly round with numerous side tubers set in five different directions like a star. They are covered with light, fibrous material. Tubers do not have very good keeping quality. They are white and soggy.

495, Mindoro Gabi. A variety of dasheen giving the largest and highest production of main tubers, sometimes 4 kilos per hill. Leaves broad and large, supported by long and large petioles. The main tuber is large, flat and round like a turnip, the size being 12 cm. diam. or more and 14 cm. long. Side tubers are numerous, close, but weakly attached to main tuber. Roots very numerous. Flesh of tuber is cream or yellow, upper part being mealy and lower part watery when cooked.

Chinese varieties.

1717, A variety from Hongkong, China, received from Philippine Bur. of Agric. A variety which is highly prized by the Chinese. The petiole is green below, and purple above; wings of sheath pinkish; it has a tendency to produce many side sprouts. The main tuber is long and slender, larger at the top than at the bottom. Side tubers long, and attached at the bottom. It is covered with a smooth light-brown skin, slightly fibrous. Flesh of tuber white, fibers few, and of bluish color. When cooked it is very mealy, and odorous.

1718, Chinese Dasheen, from Canton District, China. A variety similar to No. 1717 but tubers are larger. Tuber characters are the same as above variety.

1719, Chinese Dasheen. A variety similar to No. 1718, but flesh of tuber contains numerous large fibers.

951, Dasheen Sungsong, from Morong, Rizal. A variety similar to above varieties, but tubers are smaller, and plants are poor yielders.

II. Dark-greenish-purple varieties.

308, Los Baños Dasheen. A variety whose petioles and leaves are of dark greenish purple color. Young petioles reddish-purple near the base; inner sheath streaked with greenish purple and reddish-purple nettings. A variety which produces many side tubers, and is a fairly good yielder. Side tubers oblong, curved and of good quality. When cooked the tubers are very mealy.

944, Dasheen Malabong Pula, from Morong, Rizal. A variety similar to No. 308, but a better yielder.

1641, Dasheen Sinibuyas. A variety similar to No. 308.

1648, Calamba Dasheen. A variety similar to No. 308.

1711, Dasheen Karayo, from Oriental Negros. A variety similar to Calamba dasheen in color, but larger and taller. Tubers are covered with rough dark-brown fibrous material. Numerous roots are attached to main tuber and sprouts. Main tuber large, being 16 cm. in diameter and 24 cm. long. Flesh of tuber white, with numerous and rough fibers; very delicious and mealy.

III Streaked-colored varieties.

1050, Dasheen Pinalawan, from Tanawan, Leyte. A variety whose petioles are green, streaked with cream lines along lower part of petiole, and purple on the upper part; side tubers very numerous. Flesh of tuber cream and with numerous yellow fibers.

IV. Greyish-green varieties.

950, Dasheen Malabong Puti, from Morong, Rizal. A variety whose petioles are dark-green with reddish-purple shade; wings of sheath greyish-purple; inner sheath green, with purplish-grey spots, upper petiole green with purple shade. Leaf blade long and acute. Tubers covered with dark-brownish fibrous material. Side tubers oblong and cylindrical. Flesh of tuber white, and mealy.

B. Modified Dasheens.

Varieties that have corm-like offsets combined into a multiple-headed clump; each tip throws out an indefinite number of sprouts or buds. It is possible that by close cutting the petiole has finally brought about an abnormal habit in this form. Tubers covered with dark-brownish skin. Flesh outside reddish, inside white. When cooked it tastes like potatoes.

585, 1852, Colocasia sp., from Los Baños.

1846, Colocasia sp., from Rizal Prov.

1849, Dasheen Tapal, from Aringay, La Union.

Xanthosoma

Varieties of Yautia

444, Rolliza Yautia, from Porto Rico Agric. Expt. Station.

The plant has a height of 3 to 5 feet; with spreading petioles and triangular blades. The green, glaucous petioles have a mauve line running along the wings of sheath. The basal veins at the attachment of the petioles are always naked in mature leaves for ½-1 inch from the sinus. The tubers are comparatively large and regular in shape; cylindrical, at the apex larger, and frequently somewhat bent upward; the eyes and roots are comparatively few; the interior is white, and flavor is excellent and mealy. Flowers are almost never produced in this variety. Time for maturing is from 8 to 12 months, depending upon climatic conditions. Adapts itself readily to nearly all conditions.

309, Rolliza Yautia, from the Philippine Normal School.

A variety which resembles No. 444 but plants are very variable in form and tubers. The tubers are mostly long, curved and with many eyes. Rootstock usually long. The tuber is somewhat soggy, though sometimes

mealy. Wings of sheath are open, not as in No. 444.

430, Malanga Blanca Yautia, from Porto Rico Agric. Expt. Station.

A variety resembling the true Rolliza No. 444, but petioles not glaucous, and of light green color. Tubers are large and white, and plant has a tendency to produce numerous sprouts. Tubers mealy.

436, Punyera Yautia, from Porto Rico Agric. Expt. Station.

A variety resembling No. 444, but leaves oblong and broader. The plant produces numerous sprouts. Tubers have plenty of roots, and madres are long and large. Tuber white, and of good quality.

442, Taro, Royal Yautia, from Porto Rico Agric. Expt. Station.

A variety resembling No. 444, but tubers longer and smaller.

584, Unknown variety. Plants resembling the Rolliza, but size medium and inner sheath shallow, tubers the same as the Rolliza.

587, Unknown variety. Same as the Rolliza (309). Plants small, tubers more or less cylindrical, skin less fibrous, tubers with few eyes and short. Meat white and fibrous. Madres long, and small.

588, Unknown variety. Same as No. 587.

438, Banana Tatin Yautia from Porto Rico Agric. Expt. Station. A variety the same as Rolliza (444), but plants smaller. Tubers ovoid, long and small. Meat of tuber white, and of fine quality.

1678, Unknown variety. Same as No. 309.

589, Unknown variety. A variety resembling No. 444, but wings of sheath deeply colored with purple along the base. Tubers ovoid, white and mealy.

439, Trinidad Yellow Yautia, from Porto Rico Agric. Expt. Station. A variety resembling Rolliza (309), but plants comparatively small; leaves small, not broad, less vigorous. Poor producer of tubers. Flesh of tuber white, and of good quality.

443, Grey Jack Yautia, from Porto Rico Agric. Expt. Station. A light green-colored variety. Leaves many and short, but wide. Plants dwarf but vigorous. It flowers in the months of September and October. Petioles short, supporting leaf blades in downward position. Plants produce numerous suckers. Tubers ovoid, flat and curved and covered with light-brown hairy or fibrous material. They are strongly attached to the madres.

434, White Tamma Yautia, from Porto Rico Agric. Expt. Station. A variety similar to Rolliza (444), but tubers to be like those of No. 443. Plants are small.

1720, Unknown variety, from The Phil. Bur. of Agric. A variety similar to No. 309 in shape of tubers and upper characters of the plant.

1721, Unknown variety from the Phil. Bur. of Agric. A variety whose leaves and petioles resemble those of *Alocasia*. Most characters appear to be those of the Manola group. Petioles, green with purple color along the wings of sheath; young petioles spotted with purple, small. Sheath wings, instead of being opened as in most varieties, are closed and rolled in. Leaves are thin and veins not prominently shown. The plant is a very good producer of suckers, and sprouts appear from the sheath of the petioles. Tubers are attached to each other, and of yellowish color. No side tubers are produced.

1521, San Fernando Po, from Lilio, Laguna. A variety whose color of blade and petioles is dark-green, with purple along wings of the sheath. The purple color is prominently shown in young petioles. Petioles long and narrow, and leaf small. Tubers ovoid

in shape, and skin not fibrous; excellent in quality. Flesh of tuber light-rose in color and very mealy. This variety was obtained from a cold place, and it is supposed to have grown as high as 2 to 3 meters or more, but due to changes in environmental conditions, the plant is greatly reduced in vigor and production.

441, My Lady Yautia, from Porto Rico Agric. Expt. Station. A variety which resembles the San Fernando Po variety in color, but has more reddish color along the base of young petioles. The plant is large, and leaves small and triangular, supported by stout, short petioles. Madres long, bearing long, nearly cylindrical, ovoid tubers. Flesh of tuber reddish, but fibrous. The tubers are weakly attached to the madre, the former being of reddish color. This variety flowers.

440, Prieta Yautia, from Porto Rico Agric. Station. A variety whose petioles are blackish-purple, suffused with a glaucous bloom; leaf blade is normal in shape, but the color is very dark, while midrib and larger veins, especially in young leaves, are of pronounced purplish tinge. Tubers are nearly cylindrical or oblong, covered with a brownish fibrous material, being thick at the top. Flesh, purely yellow and very mealy. A variety which contains the highest *per cent* of starch. Tubers are strongly attached to the madre.

Alocasia

Colored Varieties

1057, Talian Itum, from Leyte. A variety 1½ m. high. Petioles greyish-pink or green; young petioles greenish-pink with green streaks; base of petiole reddish-purple. Leaves ½ m. broad and 1 m. long; midrib of leaf blade cream with greyish-pink below near the petiole; at apex cream.

1059, Talian Burag, from Leyte. A small variety, ½ to 1 m. high. Petioles short and broad, but the color the same as above with the exception that the purple color is less prominent; sheath wings are widely opened.

Green Varieties

1058, Talian Busog, from Leyte. Petioles all green. Height of plant 2 meters or more; leaf blade 1½ m. long, and 1 m. wide; petioles 1 m. long. Slight pink spots are found along the sides of the green petioles.

121, Talban Tuberculo, from Samar. A green variety, whose leaves are rough and concave, not serrated, set vertically, and supported by large and tough petioles. Madre long and tough covered with a brown fibrous material. Flesh of madre white, with a very small *per cent* of starch.

HYBRIDS. Supposed to be Alocasia indica vs. Alocasia Porteana.

121 A, Plants with petioles greenish-purple with dark-purple streaks. Leaf blade deeply serrated.

121 B, Plants with petioles dark-purple; sheath inside cream, with reddish-purple streaks; leaf blade deeply serrated.

121 C, Plants with petioles all green; leaf blade deeply serrated.

121 D, Plants with petioles green, but upper part of petiole, and young petiole, streaked with greyish-purple; leaf blade deeply serrated.

121 E, Plants with characters the same as the parent No. 121.

Cyrtospermums

Varieties of Cyrtospermums

1038, Palawan Talingaon from Leyte. Plants 1 m. high or more; sprouts abundant; flowers during the months of September. Petioles green with some white spots, and covered with sharp spines. Purple-green spots are prominently shown along the base of petioles. Petioles cylindrical, set up vertically. Leaf blade thick, large and rough. Flesh of tuber cream or yellow in color.

1039, Palawan Binabaya, from Leyte. A variety similar to No. 1038, but small, and without spines.

311, Palawan Gabi, from Leyte. Plants similar to No. 1038, but spines are less prominently shown and less numerous.

These plants are found abundantly along the swampy places of Leyte, and the beach of Calamba, Laguna. They grow to a tremendous height, sometimes 4 meters or more depending upon the conditions they grow. These aroids are very little known in the Islands. They are called *Gallans* in Laguna.

Summary

The cultivated root-producing aroids, which include the yautias, dasheens, gabis, Alocasias and Cyrtospermums, are practically new to scientific agriculture, although numerous varieties have been under cultivation since the early history of the world.

The yautias are natives of tropical America; gabis, dasheens, Alocasias and Cyrtospermums, of Polynesia and the Pacific Islands. It is recommended that distribution of the best varieties of these aroids be made throughout the tropics. It is also recommended that the Polynesian Islands be visited as soon as possible, and all the best varieties collected for thorough tests here and elsewhere.

Many varieties of yautias and dasheens of extraordinary value are found everywhere in the tropics, some of which are used for salad plants, though the main object in the growing of the yautias and dasheens in general is the production of starchy tubers. Tubers of numerous varieties are suitable for the table, and rootstocks of all varieties can be used for stock food, either fresh or preferably ground into meal. Several varieties which produce numerous and small tubers are well adapted for the production of alcohol.

The crop requires rich, sandy and well drained loam. 13000 to 25000 plants may be set per hektare, depending upon richness of the soil, varieties grown, and climatic conditions. Dasheens mature in from 5 to 8 months; yautias and gabis in from 8 to 12 months; Alocasias and Cyrtospermums in from 1 to 3 years.

The yield per hektare is from 5000 to 48000 kilos of tubers and from 2000 to 48000 kilos of madres in yautias; from 7000 to 11000 kilos of rootstocks or main tubers in gabis; 25000 to 30000 kilos in Alocasia. The yield of Cyrtospermums has not yet been determined.

Madres or rootstocks, side tubers, suckers or even cuttings of the former two can be used for seed.

Plants may be harvested either by hand, aided by a mattock, by a 10-inch plow, or by a method called castration. Plants are preferably harvested during the dry season.

These plants have no serious diseases or pests. A large green Sphingid worm does the most damage to the plants.

The tubers contain an average of 18 to 20% starch, depending upon the species and variety. Starch from yautia is white and crystalline, and even better than that of cassava. Alocasias, and perhaps Cyrtospermums, contains a very low percentage of starch, running from 2 to 5%.

Improvements of the aroids may be obtained by proper methods of selection and cultivation. The use of vigorous plants and large seed cuttings is advisable. Fertilizers and irrigation are necessary to get a maximum production of vigorous plants and of tubers. Good and selected seed stock is an item of agricultural importance.

All of the cultivated aroids may possibly become important as catch crops or intercrops among bananas, cacao, coffee, rubber or coconuts.

Cultural Notes on Upland Rice in the Philippines

By Marcelo Crisostomo y Salamat

Thesis presented for graduation from the College of Agriculture No. 20

Rice is now more or less extensively cultivated in nearly all tropical and semi-tropical countries and constitutes the staple food of half of the human race. It was reported during the year 1911 that 1,043,757 hectares of land in the Philippine Islands were used for growing rice, producing 882,794.13 metric tons of raw rice (palay); probably approximately two-thirds of this area was occupied by upland varieties.

The cultivation of upland rice in the Philippines is mainly handled by primitive methods. Its culture in the heavier producing section does not at present form a part of the system of diversified farming which is essential for the upbuilding of the soil; nor does any single crop system furnish the mixed diet which is necessary for the proper development of a strong and healthy race of people. While the method of culture at present is rather primitive, new ideas are being taken up to some extent.

The depth of surface soil for rice need not be very great, 7 or 8 inches being enough. The temperature required by rice is about 14° C. for germination, and about 25° during the growing period.

The degree of improvement of rice cultivation throughout these Islands will certainly measure the growing intelligence of the farmers, especially the rice growers, whose prosperity probably depends more upon the condition of the rice crop than upon any other thing.

The present studies were carried out with the object of making a careful comparison of certain varieties of upland rice as to their gross morphological characters, their behavior under cultivation, their yield, and value. Some of the characters examined were:

1. Average daily growth.
2. Number of days required for maturity.
3. Amount of stooling.
4. Average number of grains in head.
5. Color, size, and shape of the grain.
6. Characteristics of the grain that affect its value as food.
7. Comparison of yields.

These points will be taken up in the order in which they are listed here.

Twenty-four upland rice varieties were sown broadcast May 31, 1912, in plots ten meters square, and covered with soil by harrowing.

The field where the twenty-four varieties were grown had been previously planted with legumes and finally with rice; but, owing to the unfavorable weather, the last crop did not reach maturity.

The total rainfall in centimeters for each month was as follows:

April, 0.33; May, 15.44; June, 8.12; July, 29.50; August, 46.00; September, 31.88; October, 4.09; November, 21.37; December, 7.07.

The rainfall for June was too scant and the plants all suffered from drought three weeks after sowing. The growth was therefore abnormal for a few weeks, but a gradual increased rainfall later enabled the plants to continue their growth vigorously. It is important in the cultivation of rice to determine the quantity of water that each variety requires and this knowledge is of fundamental value to the rice grower.

From measurements taken during the earlier part of the life of the plants used in this test, it was found that the average daily growth of the quickest growing leaf of the most quickly growing

variety was about 25 mm.; and of another good one, 23 mm. The slowest growing grew 14 mm. and the second slowest 16 mm. each day (measured by increase of length of the quickest growing leaf).

These growth measurements suggest that the different varieties might perhaps be identified in our plots by knowing only their different growth records provided they be grown under the same conditions.

TABLE No. 1

GERMINATION AND RATE OF GROWTH

Variety Local Name.	*Source of Seed.*	*% Germination.*	*Growth per day of fastest growing leaf. m. m.*	*Height of tip of highest leaf above ground. m. m.*	*Average width of leaves. c. m.*
Binicol	Los Baños	90	14.22	133.40	1.47
Kinastillo	Los Baños	86	20.20	152.60	1.59
Kinagaykay	Los Baños	85	23.24	127.32	1.51
Dinalaga	Los Baños	96	22.07	110.84	1.76
Dinagat	Los Baños	95	16.47	140.12	1.41
Tiniaong	Los Baños	99	16.68	137.92	1.45
Kalibong pula	Calamba	93	18.70	117.88	1.57
Kinanda	Los Baños	64	17.93	120.08	1.66
Dinaluquit	Calamba	71	16.17	134.04	1.49
Malagkit	Los Baños	57	17.92	112 96	1.40
Pinutat	Malolos	75	20.10	135.84	1.37
Pauni	Malolos	87	20.13	135.28	1.49
Malagkit sinantol	Malolos	69	14.45	116.48	1.64
Ipot-ibon	Malolos	77	19.47	130.56	1.61
Binuhañgin	Malolos	74	16.43	149.92	1.43
Malagkit kinabae	Malolos	84	18.83	142.72	1.31
Malagkit tinalaksan	Malolos	68	20.74	126.84	1.46
Binulagsak	Malolos	85	23.86	134.64	1.68
Caviteña	Malolos	78	20.76	144.24	1.50
Balibod	Malolos	83	21.07	143.84	1.44
Macan cumpol	Malolos	77	20.85	144.60	1.54
Macan	Malolos	96	20.99	134.12	1.50
Minalit	Malolos	82	22.59	144.56	1.46
Pinursigui	Malolos	94	25.88	147.08	1.48

The time needed to reach maturity differs so widely in different varieties, that we can group them according to the number of days which they need to reach maturity as follows:

Early varieties.....100 to 150 days.
Medium varieties.....150 to 180 days.
Late varieties..... more than 180.

Of course it is impossible to sharply distinguish varieties of rice according to time of maturity, especially where climatic conditions vary considerably. In districts where soil and climate are nearly uniform such a grouping may be very useful. The varieties that mature quickly are of course preferable, because they are harvested in a shorter time, and require shorter periods of care.

The two earliest varieties that were harvested are Dinaliquit from Calamba, and Tiniaong from Los Baños. The former took 105 days from sowing to maturity and the later 127 days. The two latest varieties as determined from this test are Malagkit kinabae from Malolos, Province of Bulacan, and Minalet from the same place. The former took 180 days from sowing to maturity and the latter 194 days. Two medium period varieties are Ipot ibon from Malolos, Province of Bulacan (177 days) and Pinursigui from Malolos (179 days).

The varieties that produce the most stems per stool are not necessarily those that give the greatest yields; thus the varieties Pauni and Binuhañgin that have about the same number of stems per stool gave yields of 44 and 27 cavans per hectare respectively.

The upland rices can be classified as glutinous or non-glutinous. The dis-

tinction has been noticed from ancient times. There are no remarkable differences in the morphological characters between these groups, but glutinous rices have generally more tender leaves than non-glutinous rices, so that their straw is more valuable for many purposes. The principal difference is in the character of their grains. Those of the glutinous rices when fully ripe and well dried become quite opaque and have a silky white color; but when steamed they become much more transparent and show more viscosity than those of the non-glutinous rices.

It has been found that starch of some rices gives a reddish brown color when zinc chloride in iodine is added to it, and that such a reaction always appears with the starch of glutinous rice. Iodine colors the starch of glutinous rice from yellowish to brown, while it turns that of non-glutinous rice violet. This would seem to indicate that glutinous rice contains dextrine replacing starch. It has been determined that a part of the starch is replaced by sugar and dextrine, and that the endosperm of the glutinous rices contains only a small percentage of common starch.

Four varieties were analysed for nitrogen. The results are as follows:

	Nitrogen.	*Proteid.* ($N \times 6.25$.)
Glutinous:		
Malagkit tinalaksan	1.26%	7.87%
Malagkit binalintin	1.116%	6.97%
Non-glutinous:		
Dinalaga	1.06%	6.63%
Kalibong pula	1.00%	6.25%

The grains of different varieties vary in length and thickness. According to the length of the unhulled grains we can classify them as long, medium or short.

The grains of some rices are extraordinarily long, their length exceeding three times their breadth; these will be called slender grains. Those grains whose length is between two and three times their width will be called intermediate grains. Those whose length is less than twice their width will be called broad grains.

The rice grains in the twenty-four varieties grown were grouped according to the shape and size of the hulled and unhulled grains as follows:

TABLE No. 2.

AVERAGE DIMENSIONS OF GRAINS IN MILLIMETERS.

	UNHULLED GRAINS			HULLED GRAINS.		
Variety Local Name.	*Length.*	*Breadth.*	*Thickness.*	*Length.*	*Breadth.*	*Thickness.*
Ipot-ibon	8.10	3.00	2.70	6.00	3.00	2.00
Balibud	7.90	3.00	2.63	6.00	2.40	2.50
Macan	8.20	3.00	2.73	6.10	2.60	1.90
Dinalaga	7.50	3.00	2.50	5.90	2.80	2.11
Kinagaykay	8.50	3.10	2.71	7.00	2.50	2.80
Timiaong	7.50	3.00	2.50	6.00	2.90	2.06
Kalibong pula	8.10	3.20	2.34	6.50	2.90	2.51
Malagkit	9.00	3.20	2.67	7.80	3.00	2.60
Binuhañgin	6.00	2.50	2.50	4.90	2.00	
Pinutat	8.10	3.20	2.68	6.50	2.74	2.40
Malagkit sinantol	9.50	3.60	2.63	6.10	3.10	1.96
Malagkit kinabae	9.00	3.50	2.57	7.40	3.00	2.36
Malagkit tinalaksan	9.00	3.00	3.00	6.70	2.90	2.31
Caviteña	7.80	3.10	2.51	6.70	3.00	2.23
Macan cumpol	9.00	3.60	2.50	5.60	2.50	1.90
Minalit	8.10	3.10	2.60	7.00	3.01	2.25
Pinursigui	8.10	3.10	2.60	6.10	2.60	2.50
Pauni	8.10	3.20	2.50	6.00	3.00	2.00
Binicol	7.75	3.25	2.38	6.00	3.00	2.00
Dinagat	8.20	3.50	2.34	5.80	2.60	2.23
Kinanda	7.50	4.00	1.87	5.50	3.00	1.83
Dinaluguit	8.50	4.00	2.07	6.10	3.40	1.79
Binulagsak	8.90	4.00	2.23	6.90	2.70	
Kinastillo	6.50	3.45	1.50	5.60	3.00	

(Concluded on page 116)

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Advise to Coconut Planters

The coconut regions have long and steadily been the most prosperous parts of the Philippines. Even a decade and more ago, when economic distress still prevailed in other parts of the islands, the districts where the coconut was the principal crop were already enjoying comfort and, therefore, peace. During recent years, with the great development in Europe of industries which required great quantities of coconut oil, the price at which copra was once produced at a moderate profit has doubled, and the growers of coconuts have grown wealthy. The countries which bought our copra are at war. Their industries are prostrated. They cannot use copra, and will not buy it at any price. Even though the war prove of short duration, France and Germany will be impoverished, and a number of years will be required for the new development of industries which were flourishing a few weeks ago. During these years, these countries will have lost their power to buy, and a return to the prices at which they have been buying our products will be impossible. The coconut districts of the Philippines are confronted, therefore, by an immediate and exceedingly acute crisis, and must face the expectation that after the crisis itself is past, there will be a comparatively long period during which their products must be marketed at lower prices than they have been enjoying. During these years following the crisis, the total demand for copra in the world will be less than it has recently been. During recent years, Europe wanted more copra than the tropics could provide. At such times any copra can be sold,—be it good, bad, or indifferent. During the coming years, it must be expected that Europe, because it is unable to buy all the copra in the world, will be able to choose what it will buy. If this is the case, there will be a market for good copra and practically no market for poor copra.

The Philippine copra producer must take measures to meet both of these conditions: the crisis, and the prospect of subsequent poor markets. To get past the crisis, he must, so far as it is possible, delay marketing his produce. To sell his produce after the crisis, he must be ready to market such copra as a poor market will receive.

The same measures on the plantation will in part serve both of these ends.

The first thing to be done is to abandon the bad practice of cutting nuts from the trees. This practice never did have anything to justify it except

the general incubus of costumbre. On any plantation which is kept decently clean, it is cheaper to pick the nuts from the ground than from the trees. However expert the pickers may be, it has never been found practicable to harvest the nuts by picking or cutting and to have the harvest be uniformly ripe. No matter how perfect the copra drying machinery may be, good copra cannot be made from unripe nuts. If poor copra from unripe nuts and good copra from ripe nuts are mixed, the mixture will sell at the price of the poor copra. Good copra can be kept for a number of months without considerable deterioration. The most of the Philippine copra deteriorates rapidly if kept at all, and if kept for a number of months will not be worth the cost of shipment.

If unripe nuts are stored, they are likely to spoil. If ripe nuts are husked and stored for a considerable time, there is still a chance to make good copra from them.

Therefore, the copra producer can pass the present crisis with a prospect of escaping the loss of his present crops by letting all nuts fall to the ground of themselves; and then husking and storing the nuts, or manufacturing copra of such quality that it can be stored until markets are likely to be reestablished. If he tides himself over the present lack of any market in this manner, he will at the same time produce copra far better than most Philippine copra producers have ever marketed in the past. In tiding himself over the crisis, he will make a change in his methods which is absolutely necessary, if Philippine copra is to be marketed with any prospect of profit, in competition with the copra already produced in Ceylon, Java, and the South Seas, during the years which will follow the close of the war. Philippine copra has long been recognized as ranking with the worst in the world. It has for years been in vain for the government to call attention to this fact. So long as Europe wanted more copra than the tropics could produce, poor copra could be sold at a wide margin of profit, and so long as the producer was entirely satisfied with his profit, it was naturally useless to urge him to change his methods. If the present crisis, bad as it is, can be made to result in a permanent improvement of our great coconut industry, it may possibly turn out in the future to have been a blessing in disguise. At any rate, let us make the best of the situation.

The College does not intend it to be understood that a planter who follows its advice will escape loss. There is no possibility of escaping loss from the present crisis. The College does not guarantee that its advice can be followed with immediate advantage. No man knows how long the European war may last, how widely it may spread, or how completely the commerce of the world may be destroyed. The College does state, and state with full confidence, that the advice here given offers the best hope there is of escaping present loss, and of finding a market for our produce whenever markets shall begin to be reestablished.

Advice is a waste of words unless it results in action. At the best, only those whom it reaches can act upon it. In the hope that this advice may be of real value, the student body is called upon to see that it reaches the people. This statement has been multigraphed in the office of the College and all student from communities which have any coconut business are urged to secure notices and send them to their families and friends, accompanied by translations which they are asked to prepare individually.—E. B. C.

The most prevalent color of rice is white, which varies from a chalky white as usually seen in glutinous rices to the transparent waxy white that is common in non-glutinous varieties. Sometimes there is a pale yellow or grayish tint. A brownish red color often changes to purple in the glutinous rices. A black color is not rare in glutinous rices. The color of the rice grain is found in the pericarp of the grain, and may be removed by polishing.

The rice grains have as a rule certain longitudinal depressed lines, and these portions of the surface, in the colored rices, may still retain some color after polishing, which often gives an ugly appearance to the finished product. To get rid of this color costs much time and labor.

Newly harvested rice possesses a very sweet odor, but this disappears in storage. The most highly scented varieties are: Dinalaga, Binicol, Binuhañgin, Kalibong pula, and Malagkit tinalaksan.

The length of unhulled rice grains, given in Table No. 2, varies from 6.00 mm. to 9.00 mm. The breadth of the grains varies from 2.50 to 4.00 mm. and thickness from 1.50 to 2.70 mm.

Experience is needed in cooking rice, because the quantity of water used varies according to the variety. Some require only a small amount of water, as in the case of Pinursigui and Tiniaong.

The following varieties, which are soft when cooked, generally need more water: Dinaliquit, Dinalaga, Binicol, Kinagaykay, Binuhañgin, Kalibong pula and Macan.

The amount of crop given by the different varieties always varies, even when they are broadcasted with the same amount of seed in the same sized areas of land and cared for equally. The two plots that gave the best crops were:

Pauni.....44 cavanes.
Malagkit.....42 cavanes.

The two poorest yields were given by:

Kinagaykay.....17 cavanes.
Pinursigui.....22 cavanes.

The yields given in Table No. 3 were estimated from the harvest on plots ten meters square.

TABLE No. 3.

TIME TO RIPEN, STEMS PER STOOL, AND YIELD.

Variety (Local name.)	*No. of days from time of flowering to maturity*	*No. of days from sowing to maturity.*	*Average length of Panicles (mm.)*	*Average number of grains from each plant.*	*Average number of stems per Stool.*	*Weight of straw per hectare kilos.*	*Amount of harvest in cavanes per hectare.*
Binicol	32	135	23.5	249	2.4	2700	30
Kinastillo	42	135	26.6	218	2.8	3900	32
Kinagaykay	31	138	26.2	165	2.6	3100	17
Dinalaga	45	134	22.5	162	2.16	3800	32
Dinagat	31	118	22.9	158	2.28	4050	30
Tiniaong	34	127	23.1	113	2.12	3600	24
Calibong pula	23	128	20.4	158	2.24	3400	24
Kinanda	33	121	25.6	248	2.12	3550	30
Dinalikuit	26	105	27.0	188	2.64	5900	40
Malagkit	34	134	26.7	150	2.4	4250	40
Pinulat	29	181	16.8	180	2.64	3900	40
Pauni	11	137	26.8	141	7.28	5050	44
Malagkit sinantol	22	145	23.1	138	4.64	4700	31
Ipot-ibon	46	177	22.7	139	3.28	4900	39
Binuhañgin	28	156	27.8	255	7.24	5050	27
Malagkit tinalaksan	37	190	26.6	152	4.56	4200	42
Malagkit kinabae	31	189	27.6	125	4.88	4550	39
Binulagsak	29	135	26.5	140	4.00	4650	34
Caviteña	37	175	19.9	131	5.08	4550	25
Balibud	34	135	26.6	151	4.08	4800	34
Macan cumpol	36	186	21.4	157	5.44	4150	31
Macan	41	188	27.4	114	5.96	4650	31
Minalit	37	194	23.6	161	6.08	4050	36
Pinursigui	69	169	27.4	184	3.60	4825	22

Summary

The preceding paper gives a statement of the yield of some Philippine rice varieties as grown on the College Farm; also the average dimensions and general characteristics of the grain of different varieties; and some measurements of the rate of growth of individual plants.

The writer is indebted to Professor Baker and Assistant Professor Cuzner for help in planning the experiment.

Current Literature

Coconuts, the Consols of the East

By Harold Hamel Smith, and Fred A. G. Pape

From the modest first edition, this work has grown in a brief two years to a volume of 614 pages of solid reading matter besides 58 pages of preliminaries, and a very compendious index. The cheerful tone of the first volume has been conserved in all the additional chapters. Mistakes are decidedly less evident than in the first edition, but are not yet entirely wanting. For instance, the palm weevil, Rhynchophorus ferrugineus, most commonly known in the British colonies of the Orient as the red beetle, is still referred to as "a small black insect." Black it sometimes is, but compared with insects in general, it surely cannot be called small. In arrangement, this book is probably somewhat superior to the old compendium of Ferguson known as "All About the Coconut." But like that book, this one gives the impression of having been added to from time to time, without any regard to continuity in the book as a whole. To page 422, there is some arrangement, at least of the chapter heads. After that, the material seems to have been tacked on as it presented itself. And throughout the work, the contents of a chapter is likely to wander widely from what the heading would indicate. The chapter on the West Indies begins with the West Indies, leads into a general discussion on roots and the choice of seed nuts, and winds up with a report from Mauritius. Copra drying would be looked up on page 361, but is discussed in many other places, for instance, on page 53. In spite of the example of Herodotus, whose writings have enjoyed some reputation in spite of being largely made up of digressions, it is safe to say that the book in hand would be much more useful if an attempt had been made to take up the various subjects it treats in some order, and to treat each of these subjects thoroughly in one place.

The disposition of the authors to say the best that is reasonable about every subject touched has resulted unfortunately in the treatment of North Borneo. North Borneo has at present practically no coconut industry. There is no doubt that a coconut industry could be developed there, and hardly any doubt that it will be developed. In fact, since the greatest drawback to the development of British North Borneo is the absence of labor, coconuts are almost certainly the most promising crop which could be planted there. But when comparison with the Philippines, and specifically a comparison of the price of land, is made the basis on which to encourage coconut planting in Borneo, the case is more than overdrawn. Land is cheaper in the Philippines, and materially cheaper than it is anywhere else in the East where titles are tolerably good. As stated on page 429, the British North Borneo Company will dispose of land at an annual quit-rent of 1s. 2d. per acre. Actually, title to land is not transferred by the company. The government of the Philippine Islands leases land at the practically uniform rate of 50 centavos per hektare, essentially equivalent to 5d. per acre. The public lands of the Philippines are sold with guaranteed title, as a rule, at the rate of ₱10.00 per hektare, or practically 8s. per acre. And taxes in the Philippines are as low as in any civilized country in the world. If, as suggested, Filipino labor is ever used in Borneo, it will have to be at a higher price than in the Philippines, for the Filipino will not go

abroad to work without some inducement.

The most salient characteristic of this book is, as already noted, its cheerful tone. This cheerfulness, moreover, is altogether tempered with sanity. Without any disposition to make the coconut industry look more promising than it really is, but rather with a constant care to avoid raising questionable expectations, the book gives the best general exposition with which I am acquainted of the real opportunities which the coconut business presents. Scattered through its pages are to be found nearly all of the best ideas which have been published on the subject. Particular attention is given to the necessity of proper preparation of copra. Intelligent care in this respect is the greatest need of the business in almost every coconut country. The discussions are everywhere ample enough so that where a good idea is suggested, the planter is given all the information he can well need to carry the idea into practice.

The book is much more than a manual on the coconut. There is hardly a subject which could interest the tropical planter which is not taken up somewhere in this work. Full chapters are given to some other crops, and almost every crop in the tropics which could possibly be raised in connection with coconuts is touched upon from the coconut planters' point of view. Because of its mass of information on other subjects as well as for what it contains with specific regard to the coconut, it may safely be stated to be the most convenient single volume which any prospective coconut planter can bring with him to the tropics.

COLLEGE NOTES

Registration this year has shown the usual increase. When the catalogue went to press last year, the number of students in attendance was 295. Three hundred eighty-two students were in attendance the first of July this year. There have been a few withdrawals, as a result of the general business depression, but in spite of the bad economic condition, the falling off this year is much less than it was last year. In forestry, the scholarships are all filled, and all new appointees, with the exception of three trained in this college, are selected high school graduates. The number of Chinese students has increased from three to six, and of American students, from one to three. In spite of the very large entering class, work has started better this year, and the new students are better provided for, than ever before.

There have been a number of recent changes in the faculty. Mr. and Mrs. Ledyard and Associate Professor Glodt presented their resignations before the end of the past school year, but all remained until the work of this year had been well started. Mr. and Mrs. Ledyard left in the middle of July, and are understood to be now working in the Graduate School of the University of California. On the occasion of their departure, the Student Body adopted the following resolution;

Resolution of Gratitude

WHEREAS, after five years of faithful service, Mr. and Mrs. Edgar Madison Ledyard will soon sever their connection with the College of Agriculture;

WHEREAS, they have rendered disinterested assistance in the establishment of the institution, and have done

great service ever since for the welfare of the students, and

WHEREAS, by their separation, the Student Body will be deprived of their service and assistance, be it therefore

RESOLVED that the Student Body render a vote of thanks in recognition of their invaluable work; be it further

RESOLVED that the Student Body wish them godspeed in their homeward journey and further success in the pursuit of their career; and be it further

RESOLVED that a copy of this resolution be kept in the records of the Secretary of the Student Body; and copies be sent to the office of the Dean of the College of Agriculture and that of the Secretary of the University; and copies be sent to the said departing teachers and benefactors as a sign of lasting gratitude of the students.

As these resolutions indicate, Mr. and Mrs. Ledyard were original members of the College faculty, when the only other members were the Dean and Mr. Cuzner. At the very beginning, Mrs. Ledyard taught all of the non-technical subjects in the early part of our course: English, German, Algebra, and Geometry. She is an earnest, industrious and experienced teacher, with a large measure of natural ability to teach. Mr. Ledyard has been the chief assistant to the Dean in the administration of the college, and has at various times acted for the dean in the latter's absence. He is a man of exceptional enthusiasm and ability to get work done. The college has taken advantage of these facts, and during his last year here, he was not only assistant professor of Entomology in charge of instruction in Entomology and Zoology, but was also in charge of the sanitation with the title of Superintendent of Buildings, Grounds and Sanitation, and was also Property Officer, Disbursing Officer and Cashier. In addition to all of this, he established, and for a time managed, a student's mess.

Mr. Glodt, beside teaching Physics and Agricultural Engineering, has had charge of the wide range of engineering work on the College Campus. He has superintended the completion of the college water system, the installation of the Electric Plant, the construction of the newer stable and laboratory, and a large amount of minor work. His resignation was expected to be effective upon the completion of the new laboratory, but was abruptly brought about a few weeks before this by the outbreak of war in Europe. Mr. Glodt was formerly an officer of engineers in the French army, and was promptly summoned to join his colors. With due regard to neutrality, we wish Mr. Glodt, personally, the best of fortune.

The vacancies left by Mr. and Mrs. Ledyard and Mr. Glodt are hard ones to fill. Mr. Davis, a teacher of long experience, has been detailed from the Bureau of Education and has assumed the teaching work of Mrs. Ledyard, and Mr. Ledyard's work as Disbursing and Property Officer and Cashier. With him comes Mrs. Davis, who takes charge of instruction in Mathematics. Nemecio Mendiola, a recent graduate of the College has been appointed Assistant in Mathematics. This department has never in the past had its own stable staff, and it is hoped that its work will show steady improvement in the future. Mr. Cuzner, formerly Assistant Professor of Agronomy, who also taught Agricultural Engineering here before the department had its own head, has returned from a year's study of engineering at the University of Minnesota, and has assumed Mr. Glodt's duties. In Entomology, Mr.

C. S. Banks, for more than a decade entomologist in the Bureau of Science, has been transferred to the College. In Philippine Entomology, he is the most experienced authority. Altogether, the College has been very fortunate in the way that it has been possible to fill the recent vacancies.

It was necessary the past summer, as during preceding summer vacations, to give a beginning course in Botany, both as preparation for students of forestry and to cut down the size of the class during the regular college year. The services of Dr. W. H. Brown of the Bureau of Science were secured for this purpose and the work of the summer class was most satisfactory. In spite of the reduction accomplished by giving this course in the summer, the class in general Botany now numbers more than 120. There are also 118 students in Plant Physiology, beside a fairly large class in forest botany, and a small class doing quite advanced work on certain problems of the physiology of plant nutrition. To properly handle this number of students is beyond the power of the faculty of the department of Botany. An attempt has therefore been made to secure the transfer of Dr. Brown from the Bureau of Science to the University. This attempt has, so far, failed.

Dr. Deming has recently been promoted to Chief of the Department of Chemistry in the entire University. The result is that he is obliged to devote considerable attention to affairs in the Manila Colleges, and to spend at least the week-end in the city. While we congratulate Dr. Deming on the appointment, the change is unfortunate for this College. Mr. Roxas, who has for three years been Dr. Deming's assistant, left for the United States in July, for further study as a University fellow. His place has been filled by the appointment of Mr. Francisco Quisumbing, one of the last graduating class. Mr. Quisumbing's graduation thesis is concluded in this number of the Philippine Agriculturist and Forester.

Mr. Bienvenido Gonzales, who has recently been assistant in Animal Husbandry, has also gone to the United States as a University fellow. He will spend the coming year at the University of Wisconsin. Mr. Alfredo Adriano, who graduated last spring, has gone to Stanford University to study Entomology.

The Regents have recently authorized a material increase in the number of student assistants in various departments. Under this authority, student assistants have been appointed in the several departments as follows:

Agronomy:
Raymundo, Mariano
Benemerito, Agapito
Gutierrez, Mariano E.
Reyes, Simon A.
Perez, Domingo
Santos, Francisco
Tuazon, Dionisio

German:
Dacanay, José Q.

Zoology and Entomology:
Aurelio, Catalino G.
Uichanco, Leopoldo B.
Balangue, Cornelio

Botany:
Espino, Rafael
Putong, Cecilio
Macasaet, Valentin
Ocfemia, Gerardo O.
Teodoro, Nicanor
Paguirigan, Domingo
Otanes, Faustino
Quisumbing, Eduardo

English:
Silayan, Hilarion
Torralba, Domingo

Physics:
Labayen, Segundo

Library:
Marquez, Francisco

Sanitation:
Avorque, Mariano

Animal Husbandry:
Cruz, Florentino
Pastorfide, Dionisio

Chemistry:
Dawis, Vicente
Montellano, Pedro
Paulican, Cenon
Leaño, Benedicto

Mathematics:
Aldaba, Vicente.

Office:
Palafox, Serapio
Santos, Gregorio
Manipol, Felix

Experiments on the Coconut. I.

By E. B. Copeland

For the use of students in Agronomy II, and for the information of others, the directions for "laboratory" work on the coconut are here published. The laboratory for this class is usually the coconut grove. The performance of these experiments is expected to serve two purposes: First, to give the student thorough first-hand familiarity with the coconut tree, and particularly with its physiology. Second, to give the student practice in the operations essential to the raising of coconuts and the production of coconut plantation products.

A technical education in agriculture of collegiate grade cannot, in my opinion, be given without experimental work through enough to achieve both of these aims. A set of directions to coconut growers might be given in an hour's instruction, without failing to touch in general terms on every practically important phase of the industry, and including a statement as to what should be done under all normal conditions on a well run plantation. These directions could be learned by heart from the printed page in a small fraction of the time which the students in this college devote to the study of the coconut. The persons who learns these directions, assuming him to have reasonable natural ability, would stand in the same relation to the student who finishes this course in the College of Agriculture, that the reasonably skilful mechanic does to the well trained engineer. The college course undertakes to give the student a thorough understanding of the fundamental principles which should guide his work. Our aim is to give our students such a thorough familiarity with the coconut tree and its behavior that, from his knowledge of the tree, he can be trusted to decide for himself at any time, and under any conditions, how the tree ought to be treated.

Agriculture is a most comprehensive science, but in spite of this fact, treated merely as a science, it would be possible to learn it from books. Agriculture is also the most practically important of all human industries. Looked at on this side, it can be regarded as an art, perfection in which depends upon mastery of the science of agriculture. There are not many people who care to study agriculture merely as a science. There is nobody who cannot practise it as an art with greater success, because of any mastery he may have of it as a science, provided always that the application of the science to industry has been made just as clear as have the scientific principles themselves.

From the information which has been collected at this college, it is possible to compile a table of directions showing how deeply the soil in a coconut grove should be cultivated when the soil at different depths has a variety of given characteristics. If we were educating mechanics, we would present such a table for them to memorize. To train engineers, we have the students examine the soil as deeply as the coconut roots penetrate it, ascertain first for themselves how the roots are distributed in this soil; then, after comparison with the observations of their classmates, decide how deeply the soil can be cultivated without undue destruction of roots. The effect of cultivation upon the soil itself has been previously learned in another class. No directions or tables of directions would equip a coconut planter to decide what cultivation can properly be given his grove, in any such competent manner as will the study of the distribution of the roots in the soil.

In the study of the physiology of the coconut, the greatest emphasis is given to growth. This is for the sufficient general reason that growth is the most convenient general index to the thriftiness of the plant. It is by no means the only such index, and growth is not in itself the most ultimately important phase of the tree's activity. But the coconut is peculiar among agricultural crops, so far as these are known, in the length of time required before any given kind of treatment or any set of favorable or unfavorable conditions makes itself evident in the yield. A season dry enough to be exceedingly injurious has almost no immediate effect on the yield of nuts, but will result in a long period of poor crops, the worst of which are not har-

vested until perhaps two years after suitable climatic conditions have returned. For the same physiological reasons, the application of fertilizers produces no immediate effect upon the crop, but does produce a prolonged subsequent effect which may reach its climax two years or even longer after the application. For these reasons, the use of fertilizers and the practice of irrigation are not convenient subjects for class experiments. Since experiments of this kind must run over a series of years, the class is dependent, for its understanding of such subjects, on instruction in class and on the inspection of work in the field. Growth, in distinction to the yield of nuts, shows the effect of good or bad treatment or conditions with reasonable promptness. It is possible from the growth of the tree in one season to forecast with a high measure of probability the yield from 1½ to 3 years ahead. Familiarity with the growth of the coconut is therefore of the utmost importance as furnishing an easy and reliable method of determining the condition of a grove and its future productivity. The students in this class have previously had in their course in plant physiology the most thorough drill in determining the rate of growth of plants in general, and of their parts, and in this course are merely given particularly emphatic drill on the growth of the coconut. This drill is expected to be so thorough that one of these students can determine, from a day's observation in a coconut grove, whether or not the trees are as thrifty as they should be, and in this way, to determine what the crop may be expected to be two years ahead, and whether or not there should be a change in the treatment the trees are receiving.

On the practical side, the student is expected to determine standards of efficiency in the ordinary operations required on a coconut plantation. The value of such standards can be illustrated by an example. From the work of one of these classes several years ago, it was concluded that a reasonably efficient laborer, during the usual working day, should be able to clean the ground for a meter around sixty trees, and to do this work thoroughly. On a certain coconut plantation, labor was being hired by the day to keep a grove clean, certain laborers being used for exactly such work as had been standardized at the college. The laborers seemed to be busy, and there was no visible reason to complain of their inefficiency; but on an average, they were cleaning only a little over fifteen trees a day. The manager was informed as to the standard which had been decided upon at the college, and proceeded to test it, calling upon his men to work up to it. Their objections lasted only one day, and the men then expressed their willingness to do the work under contract at the rate of sixty trees for a day's wage. As a matter of fact, the college student is less efficient than a good laborer, when it is a question of prolonged work. In spite of the fact that it is far above ordinary present plantation efficiency, our standard is still lower than it should be. There has been a vast amount of attention to standardization of efficiency in factory and office work, and altogether too little attention to the standardization of efficiency in farm operations.

Copra manufacture is one of the foremost industries of the Philippine Islands. Of all the industries of these islands, it can safely be said to be the worst in its practice. The farmers of the islands have been given many cubic meters of advice on the subject, and this has had almost no practical effect. In the present crisis, they will perhaps listen to advice, and some of them will probably find by experience that it is good and will continue to follow it. Our own students are not dependent upon advice or instruction for their guidance in harvesting nuts and the manufacture of copra. As a part of their regular work they do these things right and do them wrong at the same time, and the difference in the results which they themselves obtain and observe can be trusted to have more effect on their own future practice, and on their own value as examples to their people, than could any number of cubic meters or tons of counsel.

DIRECTIONS.

1. Germination of nuts. Experiment by the class as a whole. Use nuts as uniform as possible, recently fallen

(not picked or cut) from the trees, and germinate them under light shade, on ground believed to be free from termites. Place twenty nuts in each set as follows:

a. One-fourth of the nut buried in the ground.

b. Half of the nut buried.

c. One-fourth buried and with a slice of husk 8 to 10 centimeters across removed from one side near the base; the part from which the slice has been removed to be on top.

d. Piled up on the ground.

e. Hung up in pairs across a pole.

The nuts piled and hung up should be sprinkled daily during dry weather, and those in the ground should be sprinkled at longer intervals, as may be necessary. Keep record of the time needed for germination, of the weekly growth of the leaves, and of condition of seedlings up to the time of transplanting.

2. Transplanting of seedlings. Each student transplant three seedlings of known age, six months, or more. Dig hole 70 centimeters wide and 50 centimeters deep; leave open about three weeks. Fill to 30 centimeters from surface with surface soil; set seedling in, and fill around it to the top of the nut with the same soil. Protect against hogs, and keep weekly record of growth.

3. Trees are assigned to students by rows, each student having 10 to 12 adult trees. At the beginning of the year make a careful and complete description of each tree showing height and diameter of trunk, number of leaves, length of blade and petiole, number, length and width of average pinnae of fully expanded leaves, number of leaves not fully expanded and their length, number and state of development of flower and fruit clusters, and condition as regards pests and diseases. In describing the tree, call the youngest visible leaf No. 1, the next youngest No. 2, etc. Record the appearance of noteworthy changes during the year, and at the end of the year summarized these developments. Tabulate observations, making one table for July 1, and one for January 1.

4. Maintenance of clean grove. Keep careful record of the time necessary to clean by hand for one meter around each tree, and to clean the entire space between trees. Later, cultivate between trees with disc harrow and keep record of time and cost. The entire grove is to be kept in presentable condition throughout the year.

5. Count the roots on one-fourth of the base of a tree and compute the number for the tree. Four students may unite on one tree in this and the next two experiments. Report should also show the diameter of the base of the tree, the distance it reaches into the ground, and the extent to which roots emerge from the trunk above the surface of the ground. Use trees which ought to be removed.

6. The depth to which the roots penetrate the soil. Dig a trench 2 or 3 meters from the center of the tree, for one-eighth of a circle reaching around the tree, and make a record of the number of roots cut in each horizontal stratum 5 centimeters thick. The trench should be made deep enough so that no roots are cut in the lowest ten centimeters. Describe the soil and state its relation to the distribution of the roots.

7. Follow two of the principal roots from the tree to the tips and record the length of the roots and the distance from the center of the tree to the tip, direct.

8. Rate of growth of roots. Let each student work with three apparently vigorous roots. These should be cleaned by removal of the soil around them and by the use of water taking care that the roots are not injured. The surface should then be dried sufficiently to permit clear marking with India ink. Beginning at the extreme tip, mark zones of one millimeter for a distance of 20 millimeters. Record growth by zones after one day and one week and total growth for five succeeding weeks. To protect the roots and at the same time keep them moist and in darkness, it will be convenient to place each root in a homoeophatic vial containing a little water, in which the root is fastened by means of a split cork. The vial may then be inclosed in a bamboo tube, this covered with a banana leaf, and the whole thinly covered with earth.

9. Absorption by roots. The same roots may be used as in the preceding

experiment, provided they evidently remain in good condition. Each vial must contain sufficient water so that, at the angle at which it stands, at least 3 centimeters of the root is immersed. Weigh the bottle and a marked cork used for weighing; put in position, then remove and weigh again. Repeat this until you become expert enough so that each time the bottle is removed the same amount of water will adhere to the root; successive weighings will then give the same results. When this technique has been mastered, leave the bottle for three days and weigh again. Weigh at 3-day intervals for three weeks, renewing the water as may be necessary.

10. Growth of leaves of adult tree. Keep a daily record of the growth of all growing leaves of ten trees. This is most accurately done by drawing a line as low down as convenient, across the point of contact of each two successive leaves. The break in the line as growth proceeds shows the difference in growth of the two leaves. The highest line which does not break on each tree is drawn on the youngest leaves which do not grow. Satisfy yourself that no leaf grows at any point above the lines drawn on its base. Keep a record daily for four weeks, tabulating results so as to show for each day the measured difference between the halves of the same line, in lead pencil, and the actual *growth* of each leaf for the day, in ink. At the end of three weeks, this table may be submitted and if the work is satisfactory daily measurements may cease in four weeks. Weekly measurements must be continued until the total time covered by the experiment is eight months. Compare observed fluctuations, on the part of all or nearly all the trees alike, with the weather record, and draw conclusions as to the effect of light, temperature and moisture on the rate of growth.

11. Dissection of crown. Experiment by class. Carefully remove all visible leaves keeping a record of number and size. The removal should be complete down to the point of actual attachment to trunk. Then remove in succession the younger leaves keeping a record of the length of blade, petiole and sheath of each leaf. Continue this until it is no longer possible with a lens and a sharp scalpel to make clean removal of additional leaf primordia. Tabulate results showing measurements of each leaf removed. This experiment must be performed with great care to prevent breaking of the very tender tissues while the older normally invisible leaves are being removed. How old is a leaf when it becomes visible?

12. Growth of spathe. Record the first appearance of each spathe on each tree in experiment 10, indicating the number of the leaf in the axil of which it appears and the exact or approximate age of the leaf and keep subsequent weekly record of the growth of the spathe until its growth ceases. In this experiment, measure the age of a leaf from the date of its appearance.

13. Record for each fruiting branch on one tree of the preceding experiment the date at which staminate and pistillate flowers open, and thereafter record at monthly intervals the size of the fruit. Count the number of staminate and of pistillate flowers in each of the first three inflorescences. In measuring fruit give length and circumference. Cut a longitudinal section of a fruit on one large cluster at the end of each month and draw and describe it.

14. Movement of hinge. From 6 a. m. to 7 p. m., make hourly measurements of the direct distance between the two sides of a well expanded leaflet, measured 30 centimeters below the apex. Repeat observations on the same leaflets three months later.

15. Rate of transpiration. Joint experiment by class. Place a grown pinna in a large glass tube, sealing it tightly, and having a small glass tube sealed into each end. By means of a large aspirator, draw ten liters of air an hour through this tube and then through another tube where the air is completely dehydrated. At the same time, draw the same quantity of air through another set of apparatus differing only in that no pinna is inclosed. The difference in increase in weight of the two dehydrating tubes or bottles is the transpiration from the pinna. Get this figure at hourly intervals from 6 a. m. to 6 p. m., and for the night as a whole, for three successive days. Com-

pute then the daily transpiration by the entire tree. Compare results with record of temperature, illumination and relative humidity for the three days, and draw conclusion as to influence of these factors on the transpiration.

16. Make as complete observations as possible regarding Oryctes rhinoceros. The report should include description of larva, pupa and adult, breeding places, habits, length of life history, relation to coconut, and means of combatting. Illustrate by drawings.

17. Make similar study and report, with regard to Rhynchophorus ferrugineus.

18. Collection of toddy or tubá. Work under the direction of Mr. Raymundo. Each student will tap three inflorescences, appearing most nearly at the same time on neighboring trees. Report fully on the whole operation and the results, including judgment as to when the inflorescence is ready to begin work, on preliminary bending, removal of the tip, subsequent removal of slices, the beginning of the flow of sap, continued removal of slices, and the amount of sap harvested morning and evening each day while flow continues from the inflorescences. Report also any observable influence of tapping on the production of nuts, and on the presence and collection of beetles.

19. Copra manufacture. Class experiment. Use 600 nuts which have fallen of themselves, and 400 picked from the trees. Each lot should be as uniform as possible, and the picked nuts should be only such as an expert picker would harvest. Prepare copra as follows, using 200 nuts for each test.

(a) Use fallen nuts and the hot air drier.

(b) Use fallen nuts and tapahan.

(c) Use fallen nuts; husk them and store under shelter for six months. Then prepare copra with the hot air drier.

(d) Use picked nuts and the hot air drier.

(e) Use picked nuts and tapahan.

In each case, keep a full record of operations including a record of cost, figuring labor as worth 10 centavos an hour. Record in each case the yield of copra and its oil and water content. Keeping the lots separate, store the copra in the bodega, and keep monthly record as to changes in the oil and water content.

To determine the oil content of the various examples, and at different times, use the hydraulic press. Determine in one case, by extraction of the oil cake with ether, the thoroughness with which the press operates.

20. Coir. Work in groups of three, each group using three nuts;—one at its largest size, one not quite ready to fall, and one which has fallen. Weigh the entire husk, pound it, ret in fresh water and comb clean. Weigh the air-dry fiber from each husk, and tabulate results. Report for each nut the time required. These time records will show the relative difficulty of extraction, but are of no other business significance, because hand extraction of coir is not commercially practicable.

21. Coconut trip. The class as a whole will visit the towns of Pagsanhan, Santa Cruz, Magdalena, Lilio, Nagkarlan, San Pablo, and Alaminos, and will become as familiar as possible with every phase of the coconut industry of these towns. The whole class will meet in each town for comparison of observations and information, and will visit such points of particular interest as the copra driers of Pagsanhan and Magdalena. For the collection of detailed information, they will break into smaller groups, and one of these groups should visit Majayjay. The report, based on full notes made during the trip, and submitted by each student, should include all important information collected by the class. It should be prepared according to the following general outline:

(a) Narrative of trip showing day by day the movements of the individual making the report, and of the class, and including details of information secured from individual planters.

(b) Table showing the importance of the coconut industry in the several towns, including number of bearing trees, number of young trees, number of trees planted during the preceding period of three or six months, the number of nuts harvested, amount and value of coconut products, and assessed valuation of coconut plantations. This information can be secured from the Municipal Treasurers.

(c) Full reports as to particular operations including:

First, planting.
Second, care of groves.
Third, harvest.
Fourth, preparation of copra.
Fifth, manufacture of oil.
Sixth, collection of tubá and manufacture of alcohol.
Seventh, use of catch-crops and use of groves for pasture.

22. Bud-rot. In one of the upper barrios of Lilio or Nagkarlang, make a thorough search for trees infected with bud-rot, and report all such trees to the owners. Fell one such tree and burn the crown completely. The permission of the owner will be secured without difficulty because he is obliged by Provincial Act to burn it himself when notified of the presence of the disease.

23. Plantation accounts. In the course of the coconut trip, each student will secure from one coconut grower who keeps accounts complete enough to serve the purpose, a business statement showing the condition of his plantation, including the number of trees and the supposed value of trees and land; the cost of all plantation operations during one year; and the receipts. Audit these accounts, showing profit or loss, calculating the interest on money at 5%, 10% and 20%. Show also the value of the plantation as it stands, with interest on money figured at 5%, 10%, and 20%. After each report is submitted in proper form and corrected, if correction is necessary, a copy will be sent to the planter who has furnished the statistics.

This list of experiments has grown somewhat from year to year, and will continue to grow. No experiment is assigned to the class until enough information has been collected so that the results of the experiment can properly be judged. As information with regard to the coconut and to the coconut business increases, there is of course an increase in the work which can profitably be assigned to the class. This is the first year that we have had accurate enough information on plantation costs to permit competent auditing of plantation accounts. We now know enough about the local fungus pests of the coconut so that in another year the class will be expected to work with these. Observation of the results of the application of fertilizers will also probably be required by next year. Such a course should also include a study of coconut varieties. The college has seedlings of many supposed varieties, but it will be a number of years before there is an opportunity to compare these on the grounds.

The Farmer's Creed

I believe that the country which God made is more beautiful than the city which man made; that life out of doors and in touch with the earth is the natural life of man. I believe that work with nature is more inspiring than work with the most intricate machinery. I believe that the dignity of labor depends not on what you do, but how you do it; that opportunity comes to a boy on the farm as often as to a boy in the city; that life is larger and freer and happier on the farm than in the town; that my success depends not upon my location, but upon myself; not upon my dreams, but upon what I actually do; not upon luck, but upon pluck. I believe in working when you work, and in playing when you play, and in giving and demanding a square deal in every act of life.

Edwin Osgood Grover.